

FORM 1010-N, 5-8-95REV 4-97[illegible]

REVISIONS			
		TDRR 23355	
		OCT 19 1965	
<p>EFFECTIVITY AND SPECIFICATIONS</p> <p>INTERFACE CONTROL DOCUMENT</p>			
MODEL	PART NO.	DESCRIPTION	APPLICABLE SPEC
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03953		A	16N01-01360-216
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TDRR 23355

OCT 10 1965

Note: Unless Otherwise Specified

1. Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts
2. North American Aviation, Inc.
Space and Information Systems Division
Downey, California
3. Design Data Required

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1.0 SCOPE

This ICD defines all of the electrical interfaces that are associated with the Command Module Guidance Computer. It will specify the characteristics, wiring, and shielding of each.

There are various input and output circuits associated with the CM. These circuits are categorized as follows:

Y, YR = Y: Input transformer circuit; YR: source for "Y" circuit.
Z, ZR = Z: Output transformer circuit; ZR: receiver for "Z" circuit.
D, DR = D: DC input circuit; DR: receiver for the DC circuit.
C, CR = C: DC output circuit; CR: receiver for the DC circuit.
S, SR = S: Switch circuit; SR: receiver for the switch circuit.
W, WR = W: Just a wire connection; WR: receiver for "W".
R = R: DC power source.

The numbers following any particular designation (C2, Y2, CR2, ZR2, etc.) together with the section numbers uniquely designate a particular CM output circuit or input circuit.

1.1 Grounding Symbolology

The following drawing symbology shall be used throughout this ICD:

a) AC Grounds

1. AC Power
2. AC Signal

b) DC Ground

1. DC Power
2. DC Signal Ground

c) Isolated Circuit Ground

d) Structure Ground

e) Vehicle Ground Point

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2.0 Waveform and Noise Measurement Techniques

1. Pulse Measurements

- a. Measurements to be made at points indicated in appropriate sections of this ICD.
- b. Measurements to be made with Tektronix 540 series, type 1A1 differential preamp, 10/1 attenuator probe; or equivalent. Scope to be grounded at CM only, if at all.

2. Noise Measurements

- a. Measurements to be made with Tektronix 540 series, type CA preamp, and P6016 current probe and type 1A1 amplifier; or equivalent.
- b. The current to voltage conversion factor will be the load pulse impedance (200 ohms; DR, Y) or DC impedance (22k ohms; CR, D) where applicable.

3. AC Measurements

- a. Hewlett-Packard 400D or equivalent.

4. DC Measurements

- a. Scope or equivalent.

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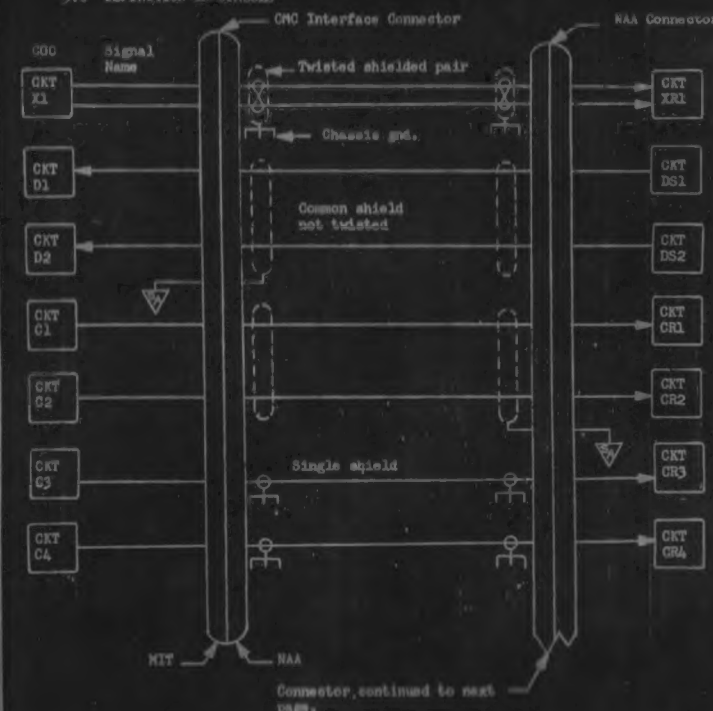
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3.0 DEFINITION OF SYMBOLS



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4.0 CMC to RSC Drivers

This section describes the interface between the Apollo Guidance Computer and the RCS Reaction Control System. The Apollo Guidance Computer will provide output-discrete to RCS reaction jet drivers to command reaction jet firing. There will be a total of 16 output lines provided, each line carrying the ignition command for one of the 16 S/N reaction jets or one of the 12 C/M reaction jets with the remaining four lines having no function when the RM is detached. The presence of high voltage on a line as referenced to spacecraft ground will indicate a jet OFF discrete.

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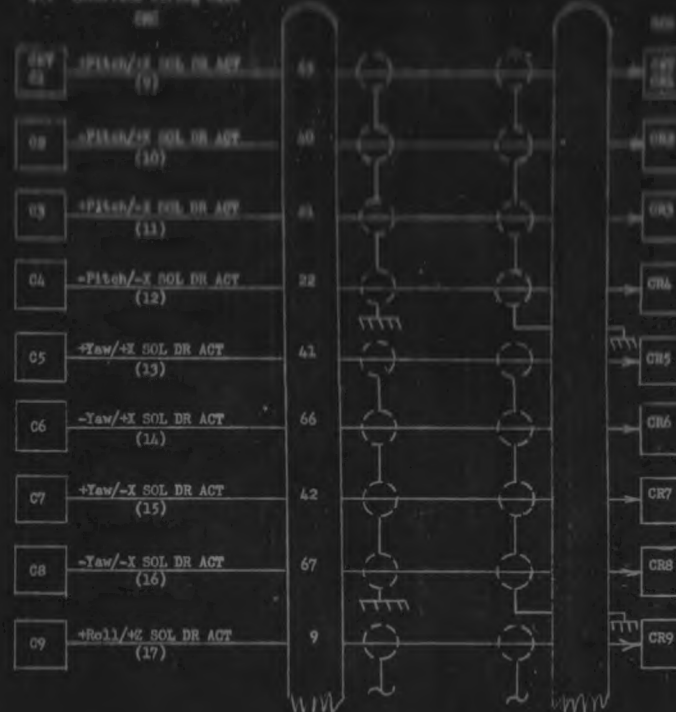
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4.1 Interface Wiring Data



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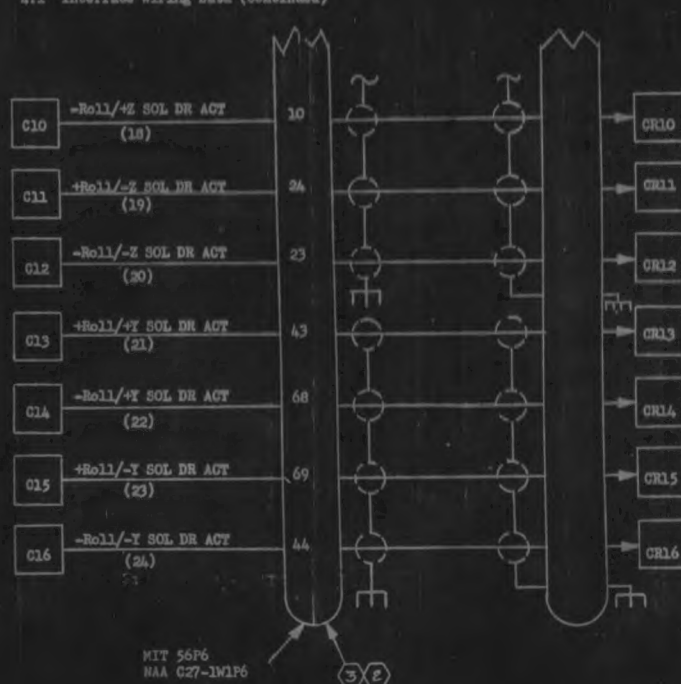
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4.1 Interface Wiring Data (Continued)



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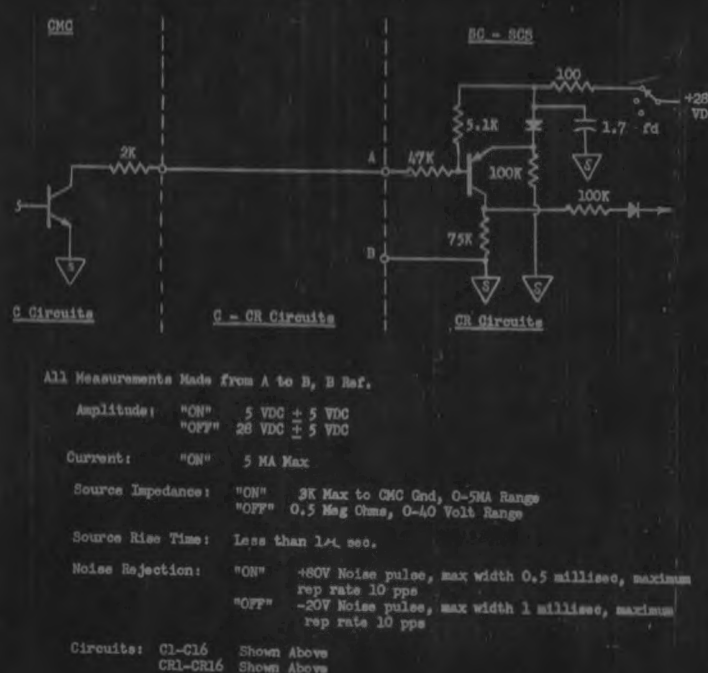
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4.2 Circuit and Signal Characteristics



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5.0 CONTROL WIRE AND STATUS SIGNALS

5.1 Signal Definitions

5.1.1 LEM Attached (ΔV CO, LEM/CM - CM)

The LEM Attached signal will be a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated upon completion of LEM transposition and docking.

5.1.2 SPS Ready (ΔV Thrust, Normal - Off - Direct On)

The SPS Ready signal will be provided by a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated and will indicate procedurally the completion of the pre Delta V checkout procedure. The SPS engine cannot be fired unless this discrete is present.

5.1.3 Attitude Hold (SC Control, CM, Auto - Hold - Free)

The Attitude Hold signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to hold the present attitude of the spacecraft.

5.1.4 Free Drift (SC Control, CM, Auto - Hold - Free)

The Free Drift signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to inhibit automatic control and permit manual control of the spacecraft through the CM (hand controllers, minimum impulses).

5.1.5 Accept Uplink (UPTM, Accept - Block)

The Accept Uplink signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time as it is desired to receive information via the update link. A similar switch shall be provided in the LEB. Both switches must be in accept position to receive uplink data.

5.1.6 C/M - S/M Separate

The Service Module Separation signal will be a parallel contact closure within the SM/CM Reaction Jet Control Transfer unit. This contact closure indicates initiation of SM separation. The contact closure occurs 110 milliseconds prior to physical separation of CM/SM. The

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switch transfer time is 100 milliseconds maximum.

5.1.7 SIV-Separation

The S-IVB Booster Separation signal will be a contact closure within the Spacecraft Master Bus, Sequence Controller. This contact closure indicates S-IVB booster separation and shall occur simultaneously with the firing of the Service Module, LEM Adapter (SLA) separation pyros.

5.1.8 Lift Off

The "Lift Off" signal will be a switch closure in the S-IVB Instrumentation Unit. The signal indicates that the IU umbilical has been removed and that the vehicle is in the lift-off phase.

5.1.9 Guidance Reference Release

The Guidance Release signal will be a switch closure in the S-IVB Instrumentation Unit. This signal will indicate that the Saturn IU external pre-launch alignment control has been removed and the IU is inertially stabilized.

5.1.10 Ullage Thrust Present

The Thrust Monitor signal shall be a switch closure in the S-IVB Instrumentation Unit. The signal shall indicate the presence of thrust on the S-IVB due to ullage.

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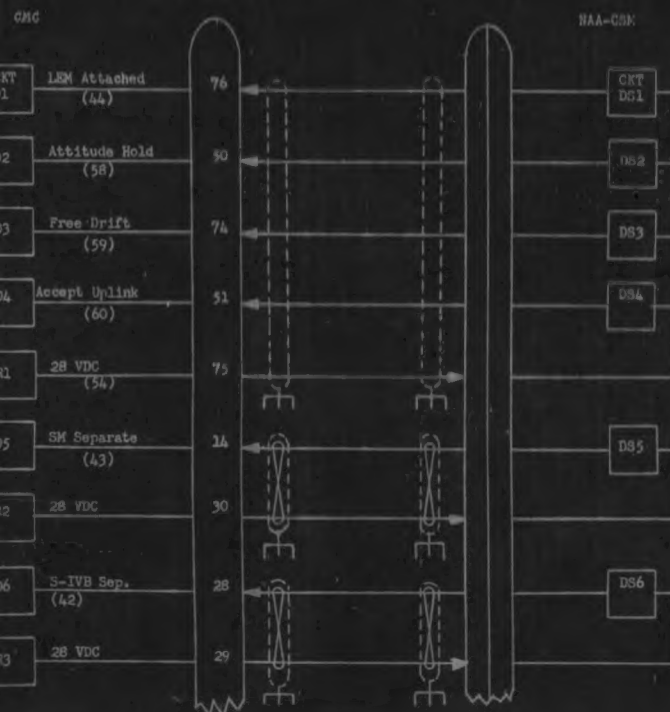
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5.2 Interface Wiring Data



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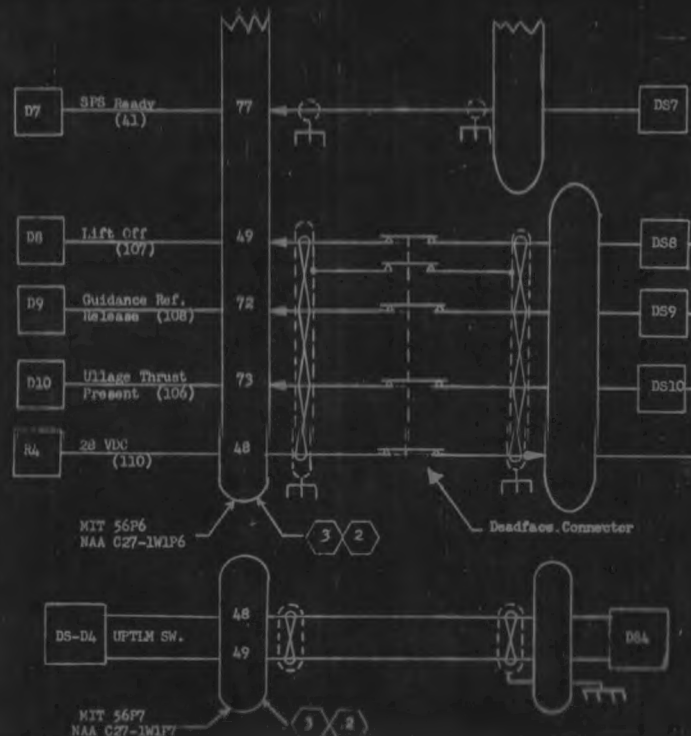
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5.2 Interface Wiring Data (Cont.)



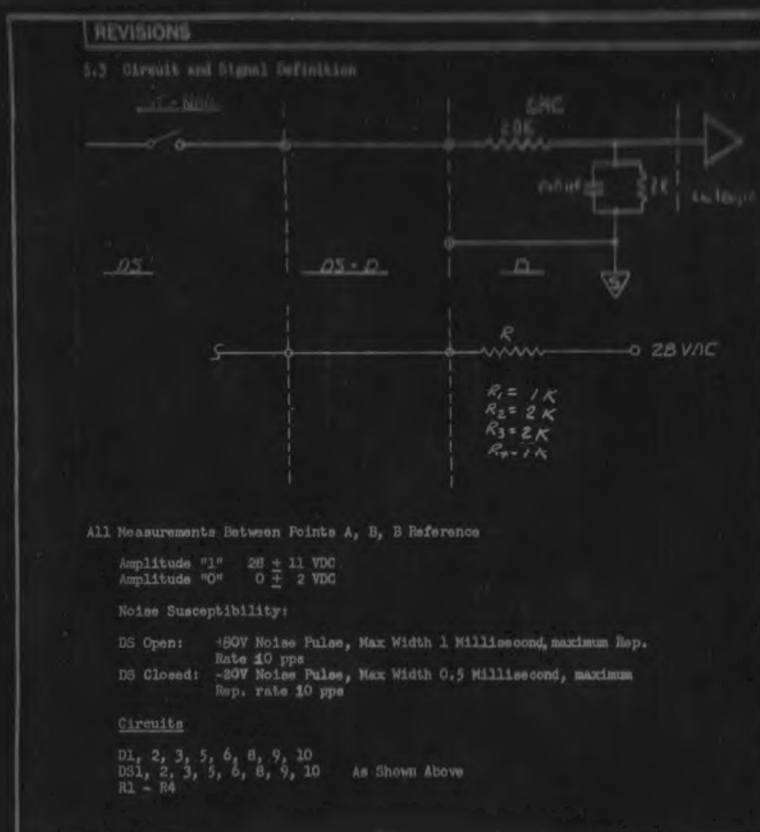
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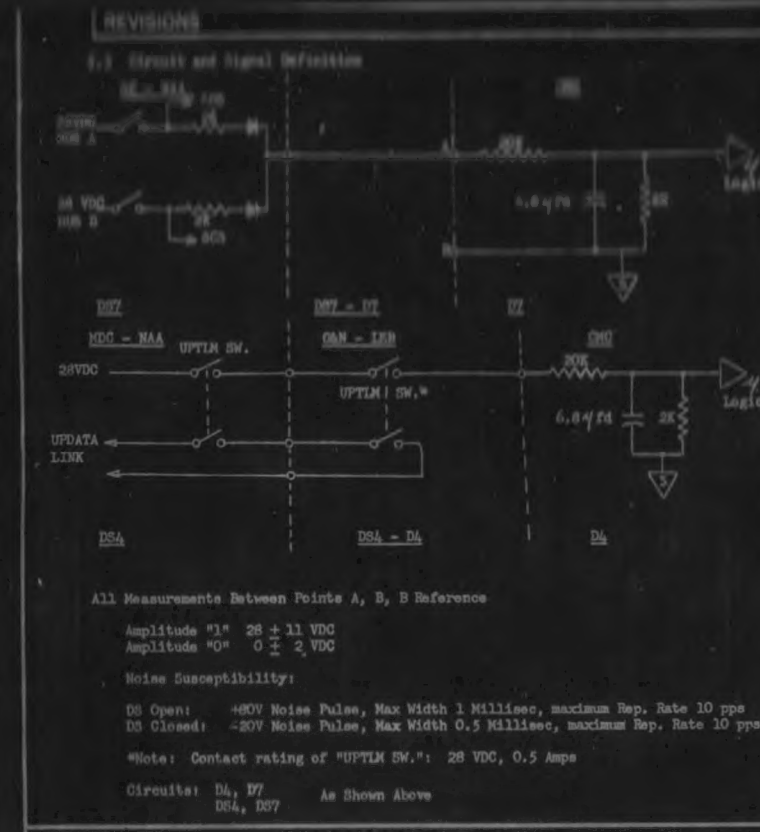
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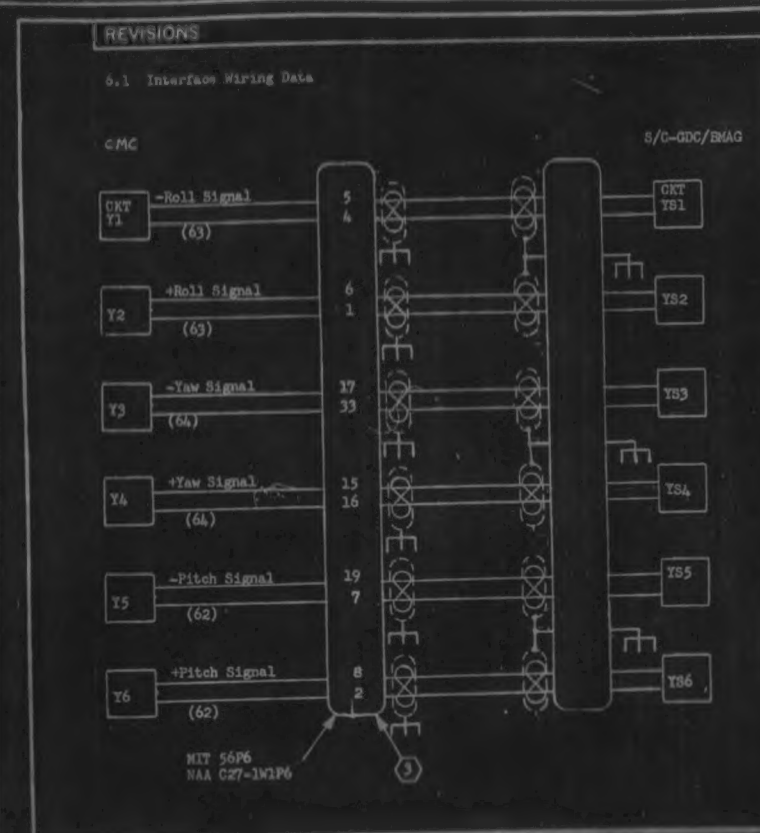
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6.2 Circuit and Signal Characteristics



Input Signal Specified at GSN Interface

1. Load Impedance: 200 \pm 10% ohms
2. Source Impedance: 100 ohms maximum
3. Signal Characteristics:
 - a. Signal Amplitude: (A) 7 \pm 3 volts
 - b. Pulse Width: (B) 2-6 μ sec (8A/2 point)
 - c. Backswing: (C) 4V maximum
 - d. Droop: (D) 20% at 24 sec point
 - e. Rise Time: (10-90% of A) 0.5 μ sec maximum
 - f. Zero Volt: The zero volt line is defined as the mean value of the waveform.
 - g. Delta Angle: Each pulse appearing on the line shall represent 0.1 \pm 8% degrees. The maximum PRF is 640 pps.

NOTE: SCHEMATIC FOR REFERENCE ONLY

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6.2 (Continued)

A. Pulse Amplitude

1. Pulse during the transmission of the pulse: The signal plus noise shall remain within the envelope of amplitude defined above (A, B).
2. Pulse during the absence of the pulse: +0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (See Figure).
3. Presence of the pulse shall indicate "ON" condition. Absence of pulse shall indicate "OFF" condition.

Circuit

- Y1 - Y6 Shown above, CMC Transformer: NASA Drawing 1006310
Y81 - Y86 Shown above

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7.0 MAIN ENGINE AND SATURN ENGINE CONTROL SIGNALS

This section describes the interface between the CMC and the SPS Drivers. The CMC provides an output-discrete signal to the SPS solenoid driver circuitry to command SPS firing. One line will be provided for this command. The presence of voltage on this line as referenced to spacecraft ground shall command main engine OFF.

In addition, the CMC will provide two signals to the S-IVB Instrument Unit. These signals are:

1. S-IVB Engine Fire Cycle

This signal will initiate the S-IVB engine firing sequence for translunar injection. The signal shall be a switch closure in the MDP-DSKY causing a 28 VDC signal to be sent to the Saturn Instrument Unit.

2. S-IVB Outoff

This signal commands the termination of main engine thrusting. This signal will be initiated by a switch closure in the MDP-DSKY and will send Saturn 28 VDC power back to the Saturn IU.

The 28 VDC power for the above Saturn signals shall be routed from the Saturn Instrument Unit through the Saturn control switch to the DSKY relays on the Main Display Panel.

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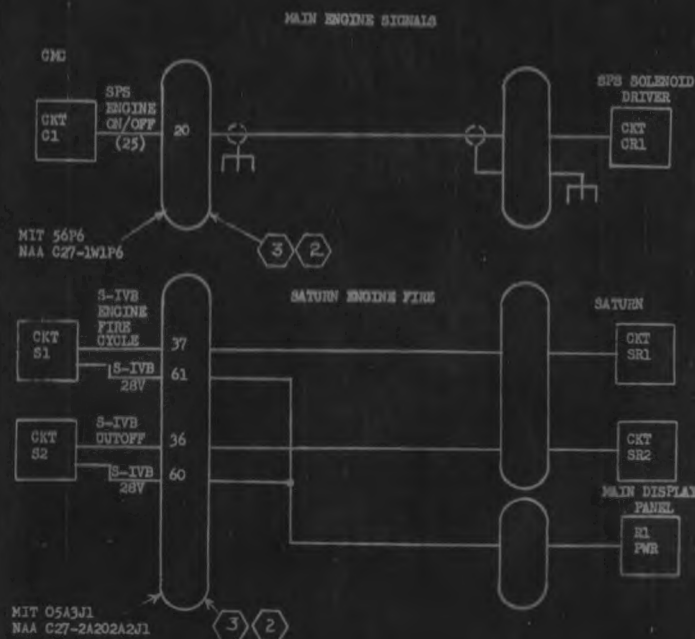
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7.1 Interface Wiring Data



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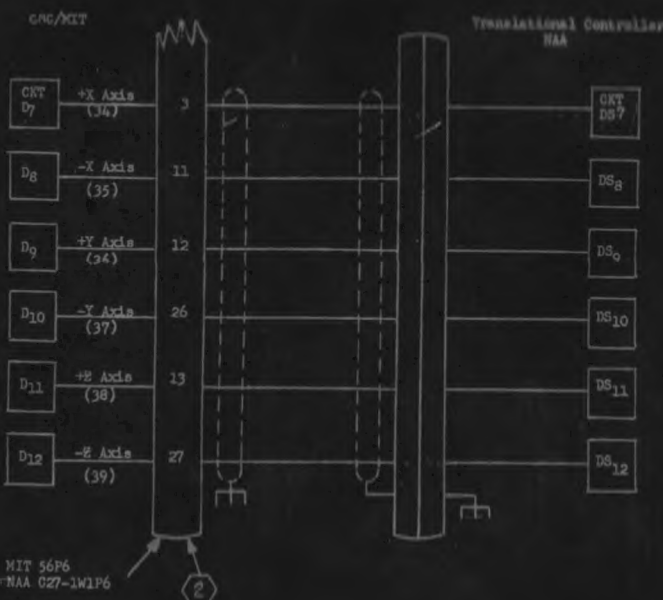
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8.1 Interface Wiring Data (Continued)

TRANSLATIONAL COMMANDS



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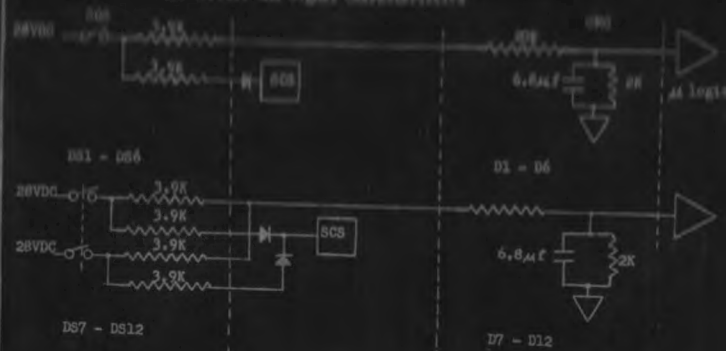
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8.2 Interface Circuit and Signal Characteristics



All measurements made from Points A to B, B Ref.

Signal Characteristics:

a. "ON" Signal

- (1) Voltage: 28 ± 11 VDC
- (2) Current: 0.01 Amps
- (3) Source Impedance: 3.9K Ohms Nominal - Rotation Control
1.95 Ohms Nominal - Translation Control

b. "OFF" Signal

- (1) Voltage: +2, -5 VDC
- (2) Source Impedance: 100K (Minimum)

c. Noise Rejection

- (1) DS Open: +80 V noise pulse, maximum width 1 millisecond maximum
rep rate 10 pps
- (2) DS Closed: -20 V noise pulse, maximum width 0.5 millisecond maximum
rep rate 10 pps

Circuits

- D1 - D12 As shown
DS1 - DS12 As shown

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9.0 MASTER CLOCK AND TELEMETRY

9.0.1 Master Clock

The G&N System shall provide a synchronizing pulse from the CMC. This timing pulse will be used to synchronize the NAA Central Timing Equipment with the Computer.

9.0.2 Telemetry

There will be two interfaces with PCM equipment:

1. Downlink - The Downlink shall consist of eight lines, two each for Downlink data, Downlink start, Downlink end, and Downlink sync. This link shall be used to transmit data to the ground via telemetry.
2. Uplink - The uplink will consist of four lines, two each for Uplink "0" and Uplink "1". This link shall be used to transmit data from the ground via Up-Data link.

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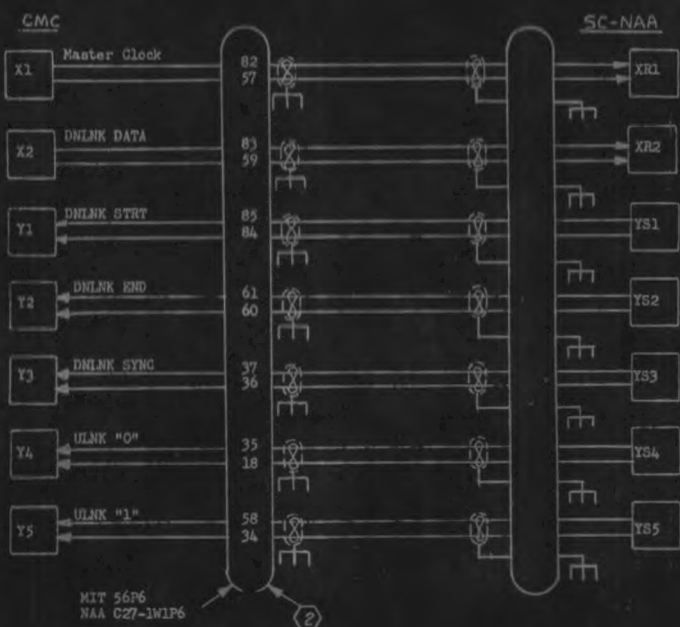
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9.1 Interface Wiring Data



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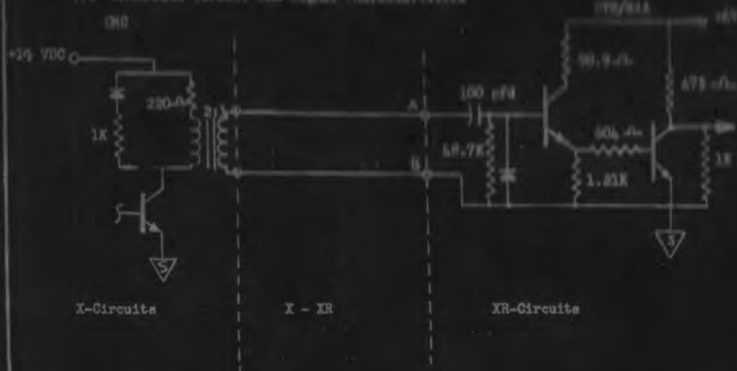
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9.2 Interface Circuit and Signal Characteristics



NOTE: Schematics Shown for Reference Only

All Measurements Made from A to B, B Ref.

1. Load Impedance - 500 ohms (approximate)

2. Source Impedance:

- Impedance during pulse - 100 ohms (approx)
- Resistance of Winding - 10 ohms maximum
- Inductance of winding - 10 mH (maximum)

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9.2 Continued

3. Signal Characteristics at G&N Interface (Test load of 510 ohms)



- Amplitude (A) - 4 to 14 volts
- Pulse width (B) - $0.5 \pm 0.25 \mu\text{sec}$
- Zero Shift (D) - 50% of A (approx.)
- Rise time (10% to 90% of A) - 0.2 μsec max.
- Noise and ripple - 0.2 volts max.
- Frequency - 1024 KC ± 2 PPM
- Zero volt line is defined as the mean value of the waveform.
- Grounding: The master clock output signal end shall be grounded isolated in the G&N System.
- Presence of pulse shall indicate "ON" condition. Absence of pulse shall indicate "OFF" condition.

Circuits

- Shown above, G&N Transformer: NASA Drawing No. 1006319
- Shown Above

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CODE IDENT NO.	SIZE	
03953	A	MH01-01380-216
		SHEET 34

FORM 8110-10 NEW 4-68

REVISIONS

9.2 Continued



Interface Signal Specified at G&N Interface

- Load Impedance: $500 \pm 10\%$ ohms nominal, note XR circuit above.
- Source Impedance: 100 ohms maximum, note X circuit above.
- Signal characteristics at the G&N Interface (Test load of 510 ohms $\pm 10\%$ acceptable)
 - Amplitude (A) $7 \pm 3V$
 - Pulse Width (B) 2.5 to 6 μsec at A/2 Point
 - Backswing (C) 6V maximum
 - Droop (D) 15% of "A" maximum at 2 μsec maximum

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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FORM 8110-10 NEW 4-68

REVISIONS

9.2 Continued

- Rise Time (10-90% of A) 0.2 μsec maximum
- Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.
- Noise Specification
 - Noise during the transmission of the pulse: The signal plus noise shall remain within the envelope of amplitude defined above (A,B).
 - Noise during the absence of the pulse: +0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).
- Presence of the pulse shall indicate "ON" condition. Absence of pulse shall indicate "OFF" condition.

Circuits

- shown above, G&N transformer: NASA Drawing No. 1006319
- to be furnished, NAA

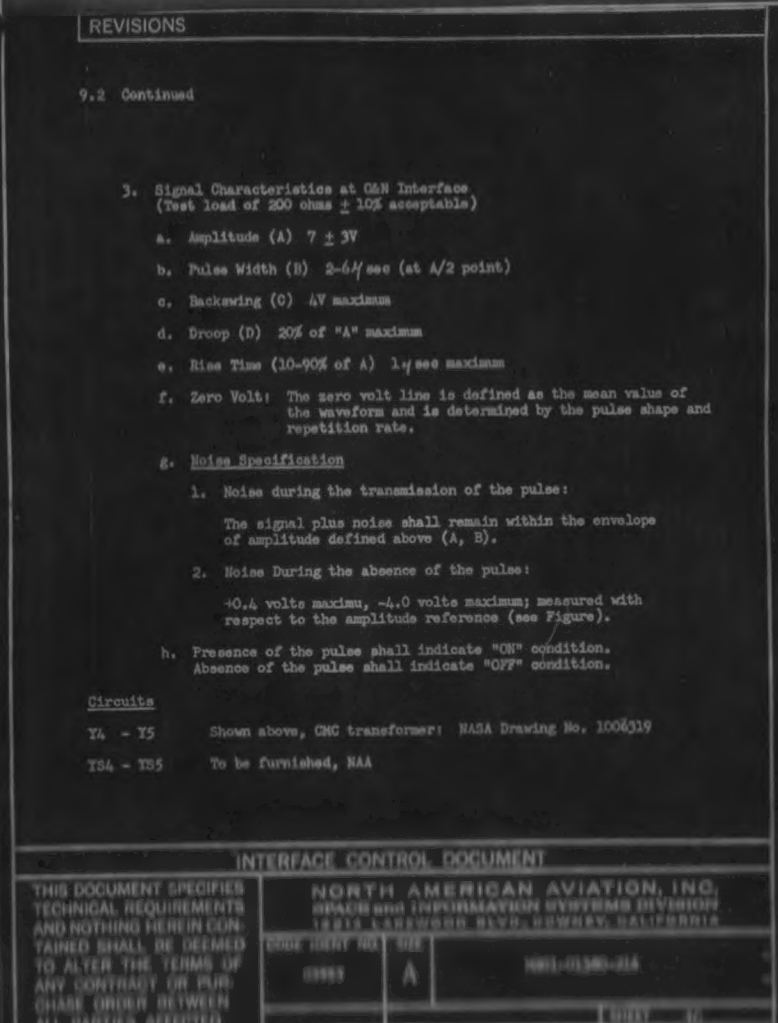
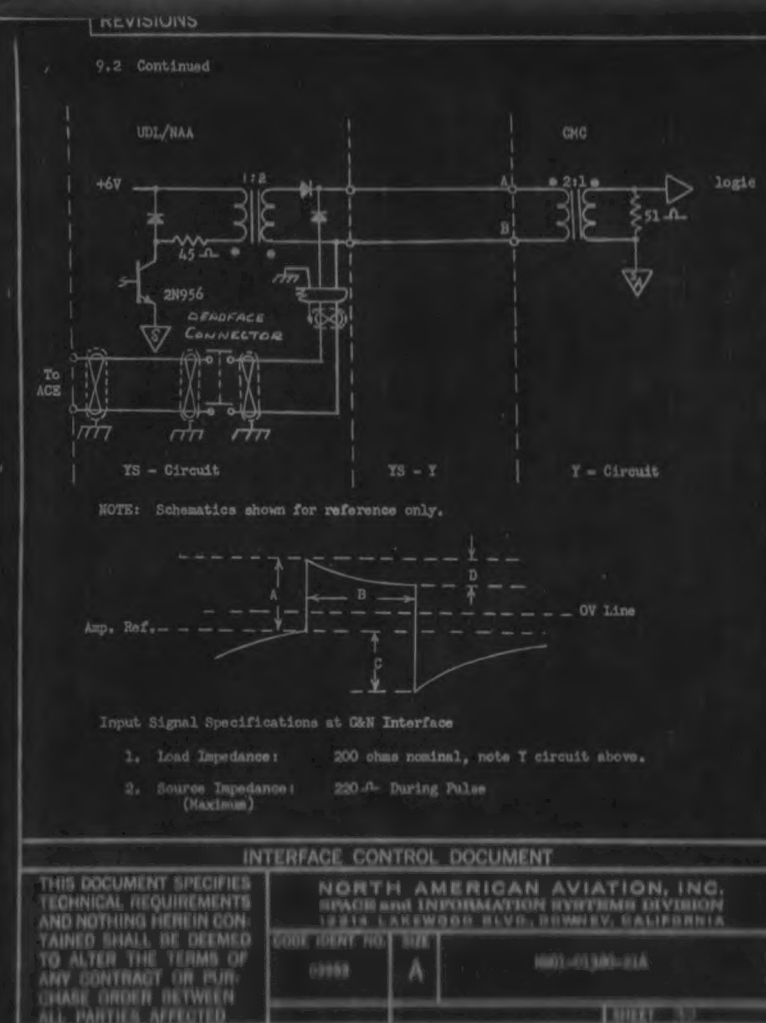
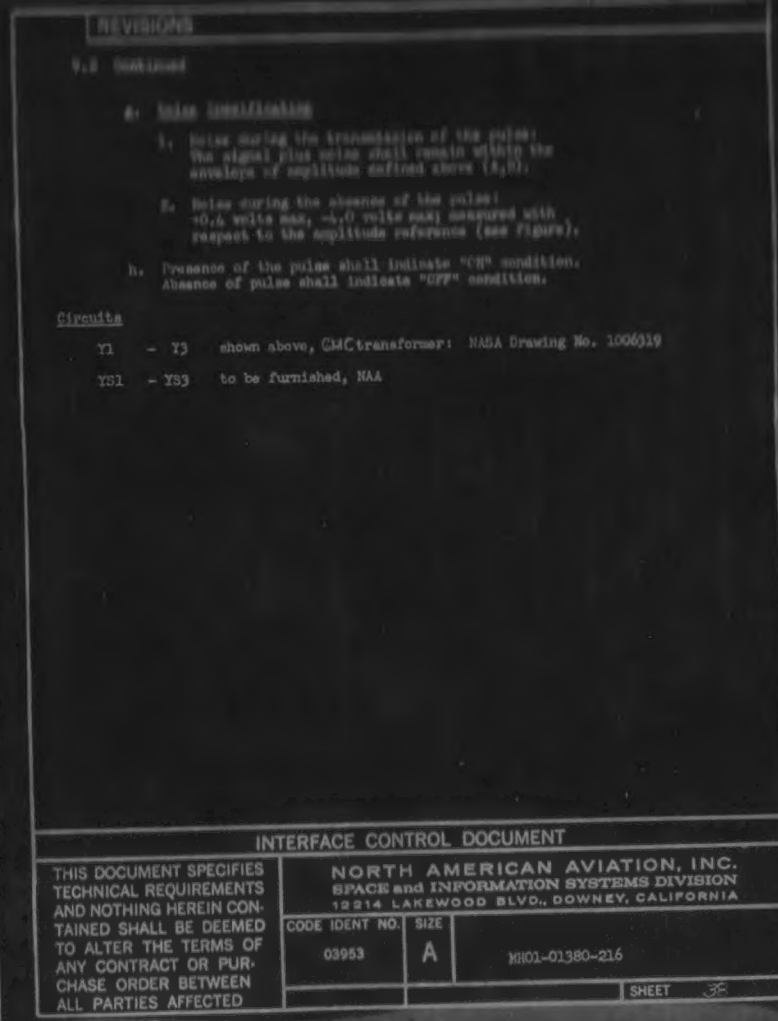
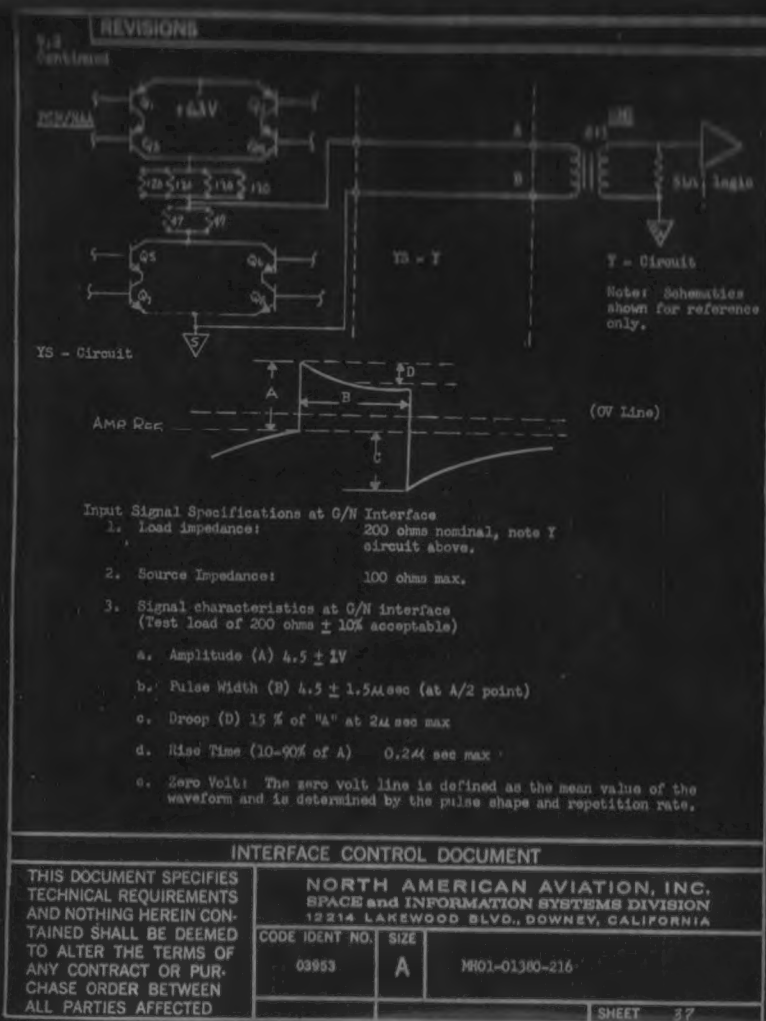
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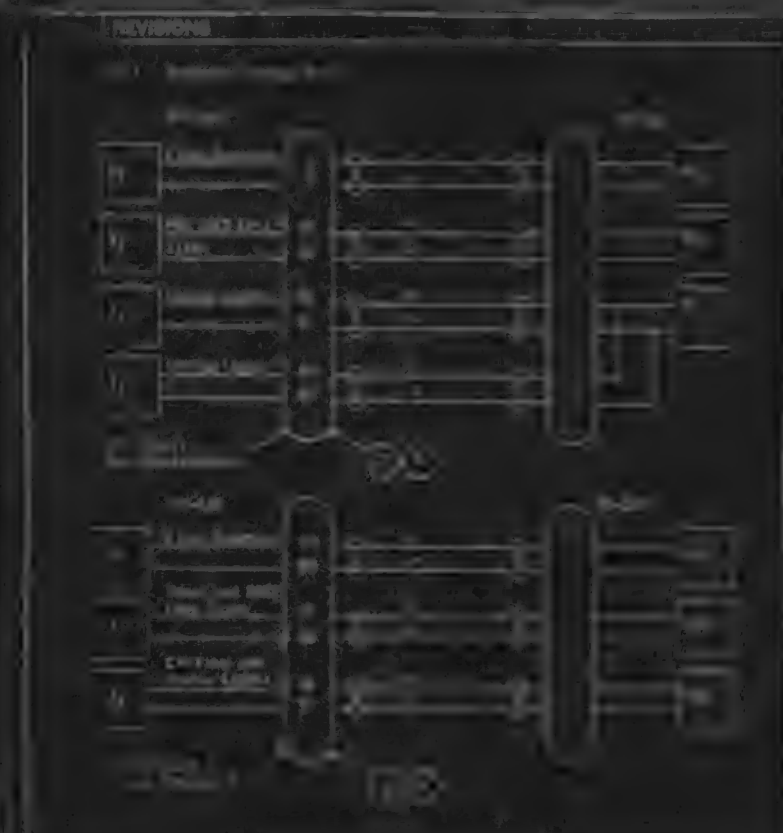
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SPACE AND INFORMATION SYSTEMS DIVISION
18215 LAKEWOOD BLVD., GARDEN CITY, CALIF. 90140

FORM 1000-100-100

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18215 LAKEWOOD BLVD., GARDEN CITY, CALIF. 90140

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60000	A

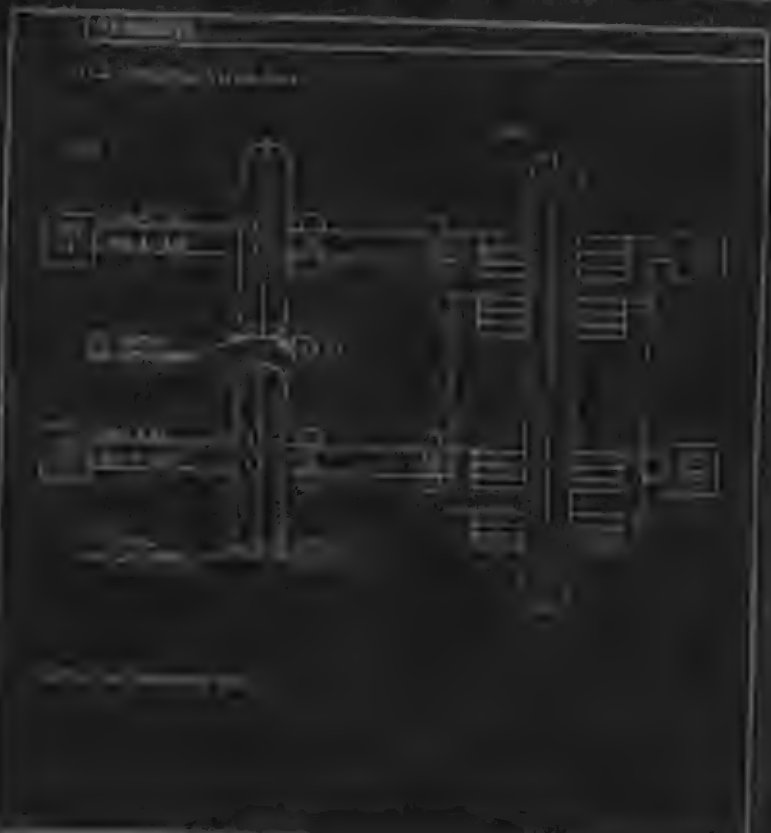


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<p>NORTH AMERICAN AVIATION, INC. 11000 WILSON AVENUE TOLSON, ILLINOIS 60140 (312) 464-1000</p>	
<p>DATE: 01/15/80</p>	<p>REV: A</p>

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1. PURPOSE
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3. REFERENCES
4. DEFINITIONS
5. REQUIREMENTS
6. TESTS
7. DELIVERABLES
8. APPROVALS
9. REVISIONS
10. DISTRIBUTION

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1 SHEET 17

1. PURPOSE
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1 SHEET 17

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12814 LAKELAND BLVD., DOWNEY, CALIFORNIA 90241

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APPROVED: [Signature]

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SPACE AND INFORMATION SYSTEMS DIVISION
12814 LAKELAND BLVD., DOWNEY, CALIFORNIA 90241

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NORTH AMERICAN AVIATION, INC.
Aircraft and Engine Division
14000 E. Harvard Ave., Torrance, Calif. 90501

FORM	A	REVISION
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Aircraft and Engine Division
14000 E. Harvard Ave., Torrance, Calif. 90501

FORM	A	REVISION
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REVISIONS

1. This document is a revision of the original document, which was issued on 1-30-66. It contains the following changes:

1.1. The signal will be initiated by a switch closure in the RDP-101 and will send Saturn 20 VDO power back to the Saturn IU.

THE DOCUMENT SPECIFIED TECHNICAL REQUIREMENTS AND NOTHING HEREIN CONTAINED SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN THE PARTIES HERETO.

NORTH AMERICAN AVIATION, INC.
 11111 North Central Expressway
 Dallas, Texas 75243

DATE	1-30-66
BY	A
FOR	11111-101-001

REVISIONS

1. This document is a revision of the original document, which was issued on 1-30-66. It contains the following changes:

1.1. This signal commands the termination of main engine thrusting. This signal will be initiated by a switch closure in the RDP-101 and will send Saturn 20 VDO power back to the Saturn IU.

1.2. The signal will be initiated by a switch closure in the RDP-101 and will send Saturn 20 VDO power back to the Saturn IU.

INTERFACE CONTROL DOCUMENT

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NORTH AMERICAN AVIATION, INC.
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DATE	1-30-66
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FOR	11111-101-001



FIGURE 1. SYSTEM SCHEMATIC

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FIGURE 2. SYSTEM SCHEMATIC

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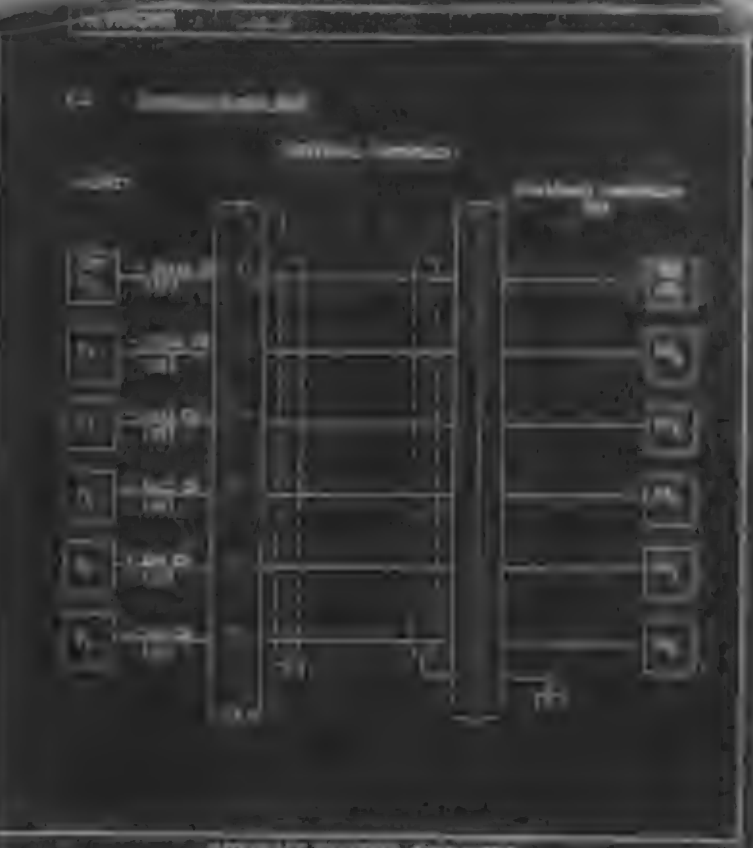


FIGURE 3. SYSTEM SCHEMATIC

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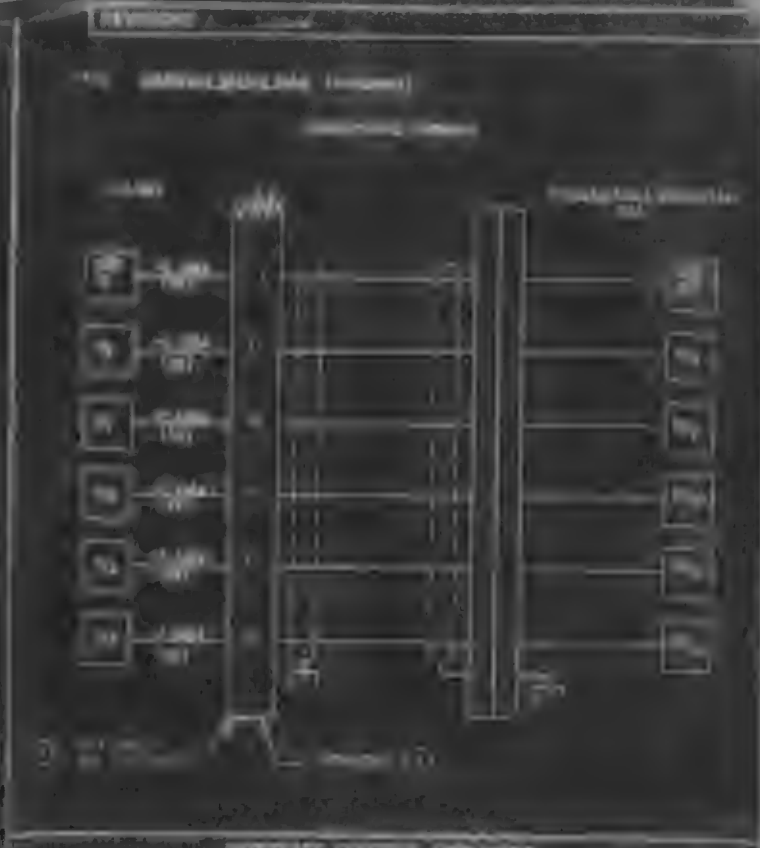


FIGURE 4. SYSTEM SCHEMATIC

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Interface Circuit and Signal Characteristics

D1 - D6

D7 - D12

"OFF" signal

Noise Rejection

Fig. 2 Noise plot, noise rate 20 pps

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LOS ANGELES, CA 90024
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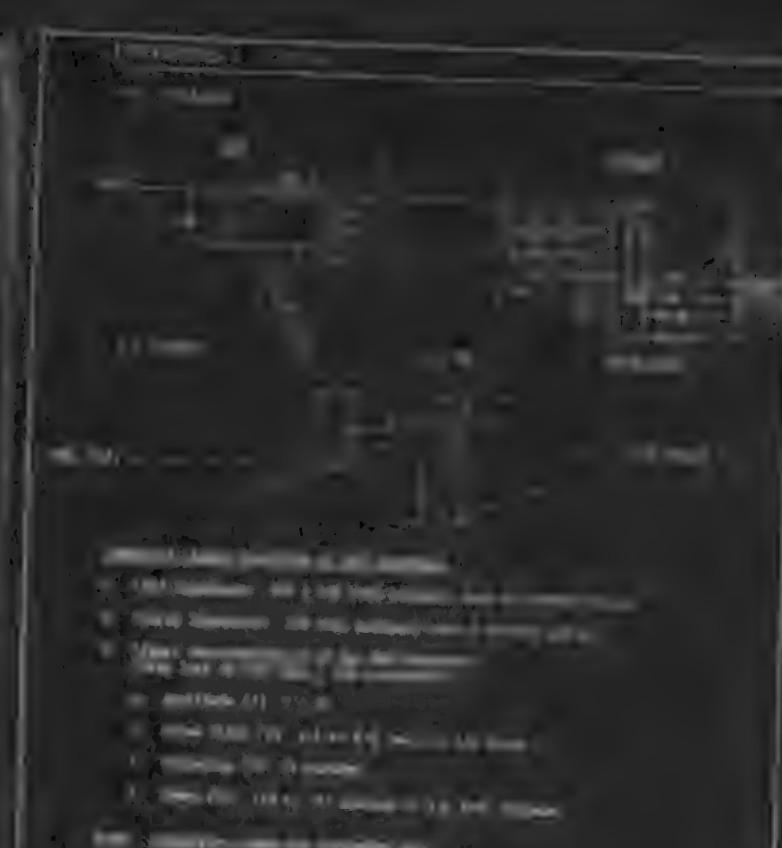
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 12345 Main Street, Suite 100
 Dallas, Texas 75201

DATE: 10/15/2010
 BY: J. Smith
 FOR: 100-1000-001



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REVISIONS

1. Rate of 0.1 sec. is a 100 cps minimum.
 2. Word is composed of 16 pulses; a "wake up" bit on 1 line followed by 15 bits on the "1" or "0" lines.

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FOR	W. J. [illegible]

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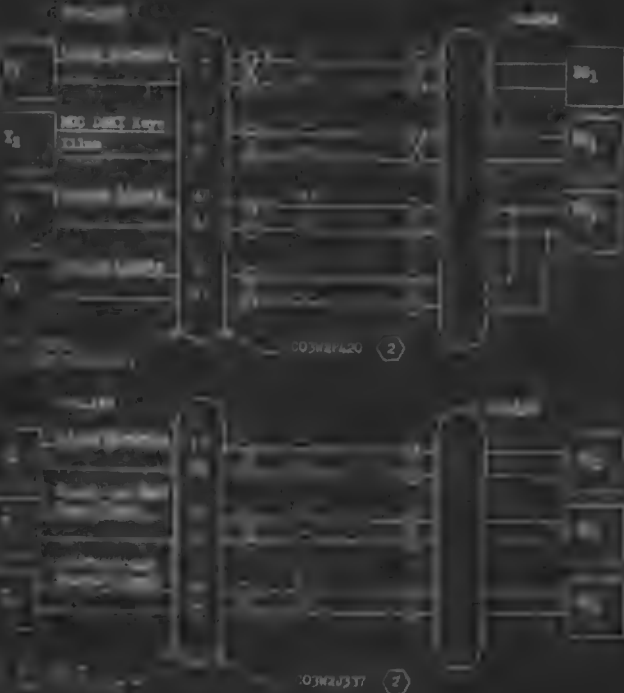
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FOR	W. J. [illegible]

REVISIONS A 1-10-66

10.2 Circuit and Signal Characteristics (Continued)



NOTE: SCHEMATIC FOR REFERENCE ONLY

All Measurements Made from A to B, B Reference

Voltage: 115V \pm 4.3 (Controlled 0 - 115 VAC)

Current: 317.5 MA \pm 75V (APPROXIMATE)

Frequency: 400 cps \pm 7 cps

VA: 23.8

Watts: 10.66 MAX.

P.F.: 0.5

Noise: Modulation: 0.5 percent

Transients: 30 to 150 volts RMS Recovery in 30 milliseconds to steady state.

Circuits: Y₁
TS₁

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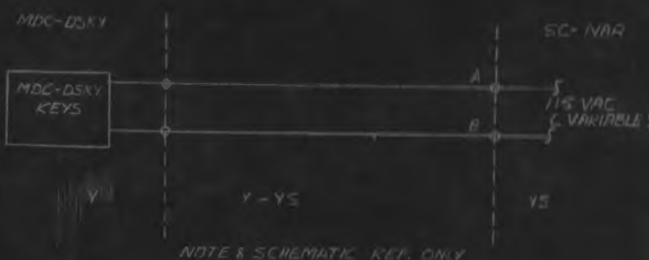
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SHEET 44

REVISIONS A 1-10-66

10.2 Circuit and Signal Characteristics (Cont.)



NOTE: SCHEMATIC REF. ONLY

All Measurements Made from A to B, B Reference

Voltage: 115V \pm 4.3 (Controlled 0 - 115 VAC)

Current: 17.5 MA \pm 75V (APPROXIMATE)

Frequency: 400 cps \pm 7 cps

VA: 1.72

Watts: 0.66 MAX.

P.F.: 0.50

Noise: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery in 30 milliseconds to Steady State.

Circuits:

Y₂
TS₂

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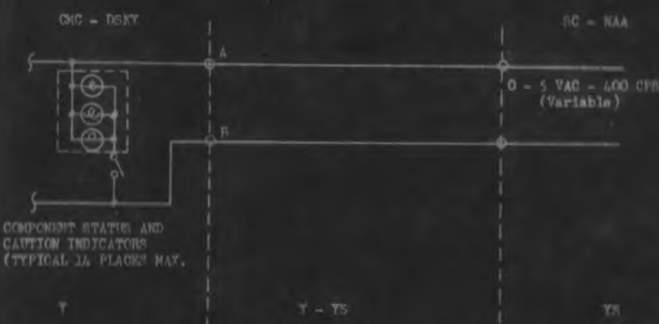
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REVISIONS A 1-10-66

10.2 Circuit and Signal Characteristics (Cont.)



NOTE: SCHEMATIC SHOWN FOR REFERENCE ONLY

All Measurements Made From A to B, B Reference

Voltage: 5 VAC Variable to Off

Current: 0.100 amps/display (caution indicators)

0.225 amps/display (status indicators)
(2.5 amps max drain on S/C System-for 2 amp unit only)

Operational Current: 720 MA (approximate)

Circuits:

Y₃ and Y₄, Y₅ As Shown Above
Y₃ and Y₄

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REVISIONS A 1-10-66

11.0 Computer to Computer Displays

This section describes the interface between the Computer and Main Display Panel DSKY. The interfaces consist of 57 lines which carry signals from the DSKY to the Computer.

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SHEET 47

REVISIONS A 1-10-66

11.1 Interface Wiring Data

CMC

CR1	Key Code 1	44	51	DS1
DS2	Key Code 2	43	78	DS2
DS3	Key Code 3	24	77	DS3
DS4	Key Code 4	42	76	DS4
DS5	Key Code 5	23	79	DS5
DS6	ARM INH	41	49	DS6
DS7	STBY	22	28	DS7
DS8	HDSST	10	48	DS8
DS9	SPARE	21	75	DS9
DS1	PWR	9	30	DS1

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SHEET 253

11.1 (Cont.)

CR1	CUTO-1	45	2	CR1
CR2	CUTO-2	46	9	CR2
CR3	CUTO-3	47	22	CR3
CR4	CUTO-4	48	41	CR4
CR5	CUTO-5	49	66	CR5
CR6	CUTO-6	28	3	CR6
CR7	CUTO-7	27	10	CR7
CR8	CUTO-8	26	23	CR8
CR9	CUTO-9	25	42	CR9
CR10	CUTO-10	11	67	CR10

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REVISIONS A 1-10-66

11.1 (Cont.)

CR11	CUTO-11	12	12	CR11
CR12	CUTO-12	13	11	CR12
CR13	CUTO-13	4	24	CR13
CR14	CUTO-14	3	43	CR14
CR15	CUTO-15	1	68	CR15
CR16	LES WARM	30	27	CR16
CR17	CHST ACT.	51	26	CR17
CR18	STBY LT.	52	25	CR18
CR19	RESTART	53	44	CR19
CR20	REL. START	54	69	CR20

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SHEET 255

REVISIONS A 1-10-66

11.1 (Cont.)

CR21	UPLINK ACT	29	47	CR21
CR22	KEY REL.	32	46	CR22
CR23	CNC WARNING	14	45	CR23
CR24	VIB/NOON FLASH	15	70	CR24
CR25	OP GRCH FLASH	16	72	CR25
CR26	PWR SYNC	5	7	CR26
CR27	TEMP CAUTION	30	71	CR27
CR28	SPARE	40	74	CR28
CR29	SPARE	17	13	CR29

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SNEET 3PK7

REVISIONS A 1-10-66

12.0 CNC MDC DSKY to Spacecraft Displays

This interface covers the signals from the OMC which illuminate the caution and warning lights in the "Caution and Warning" subsystem.

There shall be three signals:

1. GNC (Warning) - Indicates a malfunction in the GNC Power Supply or GNC Circuit
2. IRS (Warning) Inertial Subsystem - Indicates a malfunction in the IMU, PIPA Loop, CDU.
3. POMS (Caution) Primary Navigation/Evidence System - Indicates Gimbal Lock, IMU Temp out of Tolerance, Radar Failure, Program Alarm, Restart (computer).

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SHEET 114

13.2 Circuit and Signal Characteristics



All measurements made from A to B, B Ref.

Voltage: 28 VDC (nominal from S/C line)
 Current: 120 ma Steady State
 1 amp peak for 10 milliseconds
 Contact Rating: 0.5 amps (42V VDC into lamp load)

Circuits

SD1 - SD3 as shown above
 SR1 - SR3

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SHEET 1

REVISIONS A 1-10-66

13.0 Computer to Spacecraft Power

This interface covers the Power interface to the AGC and is included in this ICD for reference only. The Power Interface for the QM and C shall be covered in ICD 1001-01327-216.

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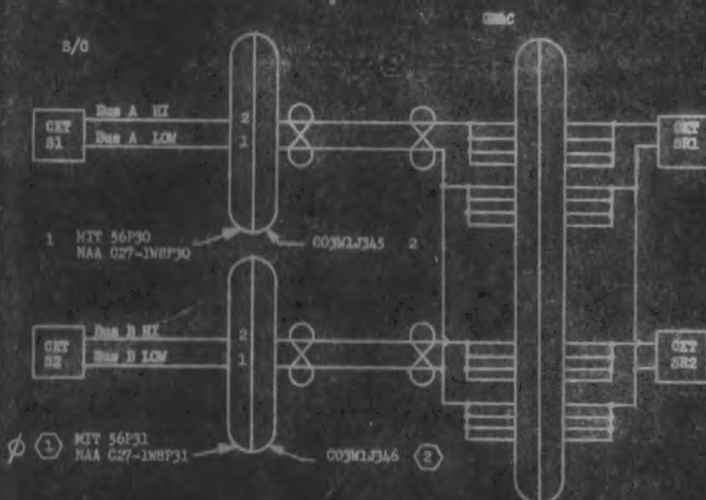
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SHEET 1

REVISIONS A 1-10-66

13.1 Interface Wiring Data



NOTE: For Reference Only

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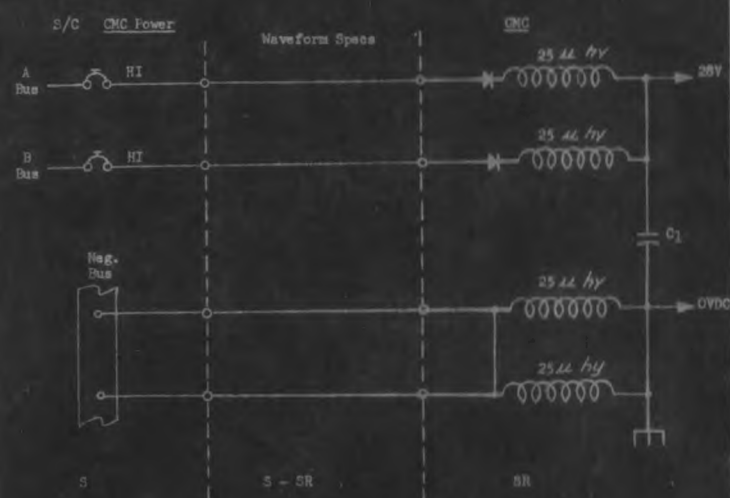
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SHEET 1

REVISIONS A 1-10-66

13.2 Interface Circuit and Signal Characteristics



All Measurements at CMC Interface

Steady State Voltage: 25.8 to 30.8 at CMC Interface
 Variations to 5.5% Per 1001-01387-216
 Current: 4.2 amps maximum

Circuits

S1, S2
 SR1, SR2

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